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THE EFFECT OF STRESSORS ON EEG ACTIVATION WITH PHOTIC STIMULATION

ABSTRACT

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   DEPARTMENT OF PSYCHIATRY AND NEUROLOGY

2. THE EFFECT OF STRESSORS ON EEG ACTIVATION WITH PHOTIC STIMULATION

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6. Supported by: U.S. Army Medical Research and Development Command
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7. This is a preliminary report of data collection and data reduction procedures being utilized on this research contract. To date seventy subjects have been studied. All subjects are being studied electroencephalographically during photic stimulation at various frequencies. The EEG recordings are being evaluated clinically for photic stimulation induced abnormalities as well as electronically using a frequency analyzer.
   The The following additional information is being collected on all subjects - 1) Medical history with major emphasis on central nervous system involvement (Mental illness, head injury, convulsions, blackout and fainting spells, headaches, etc.). 2) Response to photic stimulation - subjective experience to each frequency of photic stimulation used. 3) Performance on an embedded figure test (Witkin's format)

   A bibliography of research pertinent to the work reported is included in the report.

PROGRESS REPORT

I. SPECIFIC AIMS:

The specific aims of this study will be to determine if activation with photic stimulation under conditions of added stressors will (1) increase the incidence of activation in a normal sample, and (2) reduce the variability in activation reported in previous studies from our laboratory, and (3) to study the photic driving response transcortically rather than from only one set of cortical leads as we have had to do in the past.

II. PROCEDURES

a-subjects Subjects being used in this study are freshmen at Washington University enrolled in the basic Air Force ROTC course. To date (1 Feb. 1962) 60 subjects from this group and an additional group of 10 students have been exposed to phase I of the research programs. Phase I consists of the recording of the resting EEG and photic stimulation at 13 frequencies.

b - EEG recording and photic stimulation.

All recording is done on a Gilson EEG with output fed into a tape recorder on which four channels of EEG data, a channel for recording photic stimulation, a channel for synchronization of tape recorder with frequency analyzer, and a channel for verbal information, are simultaneously recorded.

Lead placements being recorded on the tape recorder are all bipolar and are of the parieto-occipital and parieto-temporal leads on both sides. In addition tempero-temporal lead is being recorded on paper only.

The following is the exact procedure utilized. We obtain two minutes of artifact free recording of eyes closed recording two minutes of artifact free eyes open recording before initiating photic stimulation.

Photic stimulation

Intensity of light is 300 foot candles at a diffusion screen approximately 18 inches from the subject's eyes. Photic stimulation is with eyes open, the subject being instructed to look straight ahead during the period of stimulation. Photic stimulation at the following frequencies is being utilized 4.5, 5, 6, 7, 8, 9, 10, 11, 12, 13.5, 15, 16.5 and 18 cycles per second. Forty seconds of photic stimulation are used at each frequency. If during stimulation at any one frequency the recording is disturbed (artifact stimulation at that frequency is repeated. After all 13 frequencies have been run the two frequencies producing most activation are

repeated. Should no activation occur at any frequencies 16.5 and 18 cps are repeated.

Ten seconds after termination of stimulation at each frequency the subject is asked to report his "experiences" during the photic stimulation. The wording is left intentionally vague. Though most subject elaborate only visual experiences some report experiencing kinaesthetic, cutaneous, auditory, gustatory, olfactory or visceral sensation during photic stimulation.

Upon termination of the EEG portion of the experiment subjects are administered the Witkin Embedded - figure - test. Although this procedure was not incorporated in the original proposal it was added for the following reason. The embedded - figure - test has been used by M. Fink and M. Polleck (personal communication) in a research program studying the relationship between perceptual and electro-encephalographic changes as a function of electroconvulsive shock treatments. This therapeutic procedure is known to produce transient signs of "brain damage" as demonstrated by behavioral, psychometric, as well as physiological techniques. It usually takes between 6-8 convulsive treatments (administered at the rate of 3 per week) to produce the first signs of EEG abnormality, though some patients manifest such changes after fewer, others only after a greater number of treatments. It is believed that those who show early EEG changes may have minimal brain damage prior to initiation of convulsions but not marked enough to be observable with our present, rather crude techniques for evaluating brain pathology.

Fink and Pollock demonstrated that the Witkin perceptual tasks were better predictors of when EST induced brain wave alteration would occur than was the pre-EST EEG. Poorer performance on the Witkin perceptual tasks was associated with earlier EST induced EEG changes. On the basis of their findings we speculated that if photic stimulation induced EEG abnormalities are symptomatic of brain dysfunction (see Ulett & Johnson 1958 for evidence on this point) and if the Witkin perceptual tasks are diagnostic of mild brain damage then performance on this perceptual task should be related to ease of photically activating the EEG. We discussed this problem with Dr. Witkin who recommended that as a first approximation we use the embedded figure test of his battery of perceptual tacks.

III. DATA ANALYSIS

a - Classification of "Activation" patterns induced by intermittent photic stimulation.

The schema previously developed (Ulett and Johnson 1958) and described in detail below is being used for the evaluation of the records. To date 30 records have been analyzed

jointly by the senior investigator and a physician with training in clinical electroencephalography (J. Small). Of these records three met the criteria for activation, one being classified as moderate, one as marked, and one as an extreme activator. In previous studies the incidence of these three categories of activation was 21%. On the basis of the sample evaluated to date the incidence of activation in this population is running somewhat behind that of the previous study.

Description of Activation Scale

Classification of Activation Pattern Induced by Hyperventilation or by Intermittent Photic Stimulation

1. No Irregularity
   Classify as regular those sections:
   (a) in which groups of waves of similar amplitude and frequency occur in trains without marked changes between;
   (b) those sections in which groups of waves of slightly dissimilar (1 or 2 units) frequency occur for major part of record.

2. Slight Irregularity
   To classify a section as slightly irregular LVS, LVF, MF and S, S_1, T, consider the following:
   (a) no persistent clearly defined frequency is observable, or several different countable frequencies of greater than 1 to 2 units change are seen;
   (b) the wave forms are of moderate complexity, some sine configurations are seen;
   (c) generalized slowing of 4-7/sec. frequency totaling at least 1 sec. duration in 10.

3. Moderate Irregularity
   To classify a section as moderately irregular consider the following:
   (a) predominantly non-sine wave configurations are seen;
   (b) subsequent waves are generally dissimilar in frequency and amplitude from the preceding waves;
   (c) sharp changes in amplitude are seen;
   (d) generalized slowing 0-3/sec. frequency under 100 μV.

4. Marked Irregularity
   Classify as markedly irregular those sections in which waves of at least 100 μV. are seen, at least twice the background activity. At least one definite classically abnormal wave pattern is seen, or 0-3 frequency occurring paroxysmally or over 150 μV. for less than 1 sec.

5. Extreme Irregularity
Classify as extremely irregular those sections in which classically abnormal or paroxysmal wave forms are seen for at least one second's duration. The extremely disturbed activity is over 4 times the background activity or over 150 μV.

General Considerations:

1. In the situation in which a flicker frequency is repeated or two or more classifications might be identifiable within a 40 sec. strip at a given frequency, the highest rating will be assigned.
2. "Classically abnormal wave patterns" in 4 and 5 are defined as spike and wave, single spike, successive spikes, etc.
3. The situation in which alpha patterns come and go will ordinarily be classified as regular if alpha persists over the major part of the strip.
4. A paroxysm is a sudden burst of electrical activity differing in character from the background rhythm.

b We hope to, within the next month start on the frequency analysis of the data collected to date as well as writing the necessary programs for data reduction once the results are in digital form.

Progress on Phase II of the program

Construction and installation of the audio stimulator has been completed. The stimulator consists of a white noise generator which generates a square wave signal and is tied in to the photic stimulator so that its frequency of interruption is in phase with and identical to that of the photic stimulation. The sound signal can be presented either in or 180° out of phase with the photic stimulus.

We have had considerable difficulty in shielding our audio equipment so that it would not feed artifactual information into our EEG recording. Initially we had planned to use earphones with padded earpieces to present the auditory stimuli to our subjects. Because of the close spatial relation between our temporal leads and the earphones we were unable to get rid of artifact produced in the temporal leads by the audio stimulator. We are presently experimenting with "stethoscope" type ear phones. This seems to be the most adequate solution for our problem. Should this not work we will have to do some further sound proofing of the experimental room so that we can use loud speakers mounted above the subject without interfering with other experiments being run [illegible] of the laboratory.

We have continued to scrutinize the literature for research pertinent to this contract. The following is a list of such references:

1. Ades, H. W. The EEG in relation to several types of aircraft, pilot incident and accidents. EEG and Clin. Neurophysiol., 1961, 13, 313 (a)

2. Ades, H. W. Electroencephalographic findings in relation to episodes or altered consciousness in aviators. Project MR 005, 13-3001 Subtask 1, Report No. 3 Pensacola, Fla. Naval School of Aviation Medicine, 14 February.

3. Lennox, M.-Buchthal, Buchthal, F., and Rosenfalck, P. Correlation of Electroencephalographic findings with crash rate of military jet pilots. Epilepsia, 1960, 1, 366-372.

4. McNut, D. C., Morrill, S. N. and Ades, H. W. Airborne EEG recording on aviators during acrobatic sequences. EEG and Clin. Neurophysiol., 1961, 13, 313.

5. Robert, A. and Dell, M. B. Electroencephalography as a routine medical examination of flight personnel: The Journal of Aviation Medicine, 1959, 30, (1), 68-69.

6. Rodin, E. A., Froman, C. E. & Luby, E. D. The EEG in experimental sleep deprivation. EEG CLin. Neurophysiol. 1961, 13, 310.

7. Sem-Jacobsen, C. W. Electroencephalographic Study of Pilot Stresses in flight. Aerospace Med. 1959, 30, 797 797-801.

8. Report from British Ministry of aviation reporting that pilot error accounts for about 70 per cent of British aircraft accidents.

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